Claims

1. Image recording apparatus (10) for processing an image, the apparatus including: optical sensor means (12) for recording a first digital optical image of at least a part of a scene (0) illuminated by an illuminant light and for recording a second digital optical image of at least a part of substantially the same scene under substantially the same illuminant light; the light producing the first and second images undergoing different optical processing; and means (18) in communication with the optical sensor means for processing information relating to the first and second images, wherein the processing means relates one of the first and second images to the other of the first and second images.

2. Image recording apparatus (10) according to claim 1 wherein the processing means (18) correlates the first and second images.

3. Image recording apparatus (10) according to any preceding claim wherein first and second optical sensor means (12) are provided for recording the first and second images respectively.

4. Image recording apparatus (10) according to claim 3 wherein at least one of the first and second optical sensor means (12) is relatively broadband optical sensor means, being responsive to at least two distinct wavelengths of light within a broad spectrum of wavelengths.

5. Image recording apparatus (10) according to claim 4 wherein the wavelengths are at least 100 nm apart.

6. Image recording apparatus (10) according to any preceding claim wherein the optical sensor means (12) includes at least two types of optically sensitive elements,

responsive to respectively different wavelengths of light.

7. Image recording apparatus according to any preceding claim wherein the optical sensor means (12) comprises a charge coupled device (CCD) chip, the chip comprising an array of photoelectric detector pixels.

8. Image recording apparatus according to claim 7 wherein the pixels have a broad response centering on a particular wavelength of light.

9. Image recording apparatus according to claim 7 or claim 8 wherein the CCD chip is coated with a filter (14).

10. Image recording apparatus according to any preceding claim wherein the optical processing means comprises an optical filter (14).

11. Image recording apparatus according to claim 10 wherein the filter (14) has characteristics such that its output is linearly related to its input.

12. Image recording apparatus according to claim 10 or claim 11 wherein the response of the filter (14) is a smooth function with respect to wavelength and the filter (14) has an average transmittance of more than 30%.

13. Image recording apparatus according to any of claims 10 to 12 wherein the filter (14) produces an output which includes relatively more light of one wavelength than of another wavelength as compared with the input.

14. Image recording apparatus according to claims 10 to 13 wherein the filter (14) is located in the image light path before the optical sensor means.

15. Image recording apparatus according to any preceding claim wherein first and second optical sensor means are provided by a single CCD chip (12) which records the first and second digital optical images.

16. Image recording apparatus according to claim 15 wherein the first and second sensor means may comprise respectively different parts of the chip (12).

17. Image recording apparatus according to claim 15 or claim 16 wherein the first and second images comprise different parts of the image recorded by the CCD chip (12), in spatial terms or in terms of the frequencies of light recorded.

18. Image recording apparatus according to any of claims 15 to 17 wherein a filter (14) is provided in front of or on a part of the CCD chip (12) such that the first or second digital optical image is recorded by that part of the chip, and the other of the digital optical images is recorded by the remainder of the chip.

19. Image recording apparatus according to any of claims 1 to 14 wherein the optical sensor means comprises a first CCD chip (12a) for recording the first digital optical image and a second CCD chip (12b) for recording the second digital optical image.

20. Image recording apparatus according to claim 19 wherein the chips (12a, 12b) are located in close proximity to one another, in the same geometric plane.

21. Image recording apparatus according to claim 19 or claim 20 wherein the two CCD chips (12a, 12b) are responsive to respectively substantially the same frequencies of light, the optical processing means comprising an optical beamsplitter for splitting the image light into two parts and for directing each part of the light towards a respective one of the CCD chips, and an optical filter (14) being located in the path of one part of the image light, before one CCD chip.

22. Image recording apparatus according to any of claims 19 to 21 wherein the optical sensor means and the optical processing means are located within a housing, such as a camera body.

23. Image recording apparatus according to any of claims 19 to 21 wherein

each CCD chip (12a, 12b) is provided in a separate housing, a first housing having a CCD chip (12b) provided therein and a second housing having a CCD chip (12a) and an optical filter (14) provided therein.

24. Image recording apparatus according to any of claims 19 to 21 wherein a first CCD chip is provided within a first digital camera and a second CCD chip is provided within a second digital camera, such that the different optical processing of the two images results from the different camera characteristics.

25. Image recording apparatus according to any of claims 19 to 24 wherein the two chips are responsive to respectively different frequencies of light.

26. Image recording apparatus according to any preceding claim wherein the processing means is microprocessor based, having electrical memory means.

27. Image recording apparatus according to any preceding claim wherein the processing means includes means for providing information relating to the spectral characteristics of the illuminant light.

28. Image recording apparatus according to claim 27 wherein information relating to the spectral characteristics of the illuminant light is used to facilitate removal of at least some of any illuminant colour bias present in the recorded image.

29. Image recording apparatus according to claim 27 or claim 28 wherein the processing means includes means for facilitating the removal of at least some of any demosaicing errors and/or interreflection errors and/or shadows present in the recorded image.

30. Image recording apparatus according to any of claims 27 to 29 wherein the processing means includes means for providing information relating to the physics of the scene, such as the physical characteristics of the scene.

31. A method for recording an image, the method including the steps of:
(a) recording a first digital optical image of at least a part of a scene illuminated by an illuminant light and recording a second digital optical image of at least a part of substantially the same scene illuminated by substantially the same illuminant light; the light producing the first and second images undergoing different optical processing; and

(b) processing information relating to the first and second images;
wherein the processing step includes relating one of the first and second images to the other of the first and second images.

32. A method for recording an image according to claim 31 wherein the first and second images are correlated.

33. A method for recording an image according to any of claims 30 to 32 wherein different optical processing results at least partly from the filtering of light producing the first or second image.

34. A method for recording an image according to any of claims 30 to 33 wherein the different optical processing is provided by the use of sensors responsive to respectively different frequencies of light in recording the first and second images.

35. A method for recording an image according to any of claims 30 to 34 wherein the first and second images comprise respectively different parts of a global image of a scene.

36. A method for recording an image according to any of claims 30 to 35 wherein the processing of the information relating to the first and second images provides an estimate of the spectral characteristics of the illuminant light.

37. A method for calibrating image recording apparatus, the method being

according to any of claims 30 to 36.

38. A method according to claim 37 wherein the method includes the carrying out of steps (a) and (b) for each of a plurality of different known illuminant lights and wherein step (b) includes the step of processing the information relating to the first and second images to provide an indication of the relationship therebetween.

39. A method according to claim 38 wherein the indication of the relationship is a transform function, which may be a transform matrix, and the method provides a set of reference transform functions, each transform function relating to a different known illuminant light.

40. A method according to any of claims 30 to 36 for processing an image recorded using image recording apparatus wherein the first and second images relate to a scene illuminated by an unknown illuminant.

41. A method according to claim 40 wherein the method includes the step of applying one or more of the reference transform functions to the first or second image and determining the reference transform function which best relates the two images.

42. A method according to claim 41 wherein each reference transform function is applied to the first image to produce a transformed first image, which is subsequently compared to the second image and the reference transform function which produces a transformed first image most closely resembling the second image is selected as the best reference transform function.

43. A method according to claim 42 wherein the known illuminant light to which the best reference transform function relates is determined, to provide information relating to the spectral characteristics of the light illuminating the scene to be recorded.

44. A method according to claim 43 wherein at least some of the colour bias due to the illuminating light is removed from the image of the scene to be recorded and/or at least some demosaicing errors and/or interreflection errors and/or shadows present in the recorded image are removed.

45. A method for recording an image with image recording apparatus and processing the recorded image of a scene illuminated by an illuminant light, the method including calibration steps of:

storing a digital response of an image recording apparatus to each of a plurality of colours of illuminant light $E(\lambda)$, in an electrical memory means;

grouping each colour of illuminant $E^a(\lambda)$ into a pair with a different colour of illuminant $E^b(\lambda)$, and for each pair of illuminants $E^a(\lambda)$ and $E^b(\lambda)$, calculating an illuminant transform function $T^{a,b}$, the transform function being the function which best maps the image recording apparatus response across the pair of illuminants, and recording the transfer function in an electrical memory means.

46. A method according to claim 45 wherein the number of pairs of illuminants is the same as the number of distinct illuminants, the second illuminant in each pair being defined in terms of the first.

47. A method according to claim 45 including the step of recording the responses of the image recording apparatus for a set of distinct illuminants $E(\lambda)$.

48. A method according to any of claims 45 to 47, the method further including the following image recording steps:

recording the responses of the image recording apparatus to image light (P_1) from a scene to be recorded and to optically filtered image light (P_2) from the scene;

determining which colour of illuminant $E(\lambda)$ is closest to the colour of the illuminating light, thereby estimating the colour of the illuminating light; and

removing at least some colour bias due to the illuminating light from the

recorded image and/or at least some of any demosaicing errors and/or interreflection errors.

49. A method according to claim 48 wherein the optically filtered image light is filtered using a filter which produces an output which includes relatively more light of one wavelength than the input.

50. A method according to claim 48 or claim 49 wherein the colour of the illuminating light is determined by applying each transform function T^{ab} to the recorded response (P_1) of the apparatus to the image light and comparing the transformed response (P_1) to the response (P_2) of the apparatus to the filtered image light, the transform function which best relates the two responses being the function which identifies the colour of the image light and the filtered image light.

51. A method according to claim 50 wherein the best transform function is defined as the function which minimizes the error of the operation ($T^{ab}P_1 - P_2$).

52. Image recording apparatus substantially as herein described with reference to Fig. 1 of the drawings.

53. Image recording apparatus substantially as herein described with reference to Fig. 2 of the drawings.

54. Image recording apparatus substantially as herein described with reference to Fig. 3 of the drawings.

55. A method substantially as herein described with reference to the drawings.

56. Any novel subject matter or combinion including novel subject matter disclosed herein, whether or not within the scope of or relating to the same invention as any of the preceding claims.